RELATIONSHIP BETWEEN JACK PINE BUDWORM EARLY LARVA DENSITY TO FREQUENCY OF INFESTED VEGETATIVE AND STAMINATE FLOWER BUDS[1,2]

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ABSTRACT: Population surveys of the life stages of the jackpine budworm, *Choristoneura pinus pinus* Freeman, conducted annually since 1959, detect outbreaks and delineate areas of high densities. For newly emerged early spring larvae, the number of larvae per sample was discovered to be related to the frequency of vegetative and staminate flower buds infested. We present a mathematical model for this relationship and describe its exploitation in increased survey efficiency.

Populations of the jack pine budworm, *Choristoneura pinus pinus* Freeman, have been monitored annually in Wisconsin jack pine, *Pinus banksiana* Lamb., forests by the Wisconsin Department of Natural Resources since 1959 to assess the status of this serious defoliator. On the basis of these surveys, areas harboring high numbers are deliniated and outbreaks predicted.

The pine types susceptible to the budworm often are of relatively small acreage and widely scattered: consequently, surveys are laborious and time consuming. After several years of surveying for newly emerged early spring larvae, it was observed that the number of larvae in a sample was related to the frequency of vegetative buds and flower buds infested. This research note presents a mathematical model for this relationship and describes how it can be utilized to increase the efficiency of surveys for young budworm larvae.

Methods:

Jack pine budworm larvae overwinter in the second instar beneath a webbed hibernaculum spun on the bark of their host. Soon after buds break dormancy and shoot elongation begins in mid-May, larvae emerge and mine

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into vegetative and staminate flower buds. Sampling for these early stage larvae is conducted on permanent 40 acre plots distributed throughout the jack pine type. Fifteen vegetative and 15 staminate flower buds are examined from at least 5 trees per plot, and the number of larvae in each bud is tallied. This procedure was followed from 1959 through 1966. Then it was observed that a meaningful relationship existed between the number of buds infested among the 30 examined and the total number of larvae. The critical population density of budworm larvae at which severe defoliation could be expected was empirically estimated to be 25 larvae per 30 buds. An eye-fit curve of the frequency density relationship was designed in 1967, and it was used subsequently to determine the total number of larvae on survey plots. The increased efficiency was reflected in an approximate 40% time savings per plot with no measurable decline in accuracy.

From 1971 through 1973, early larval surveys were conducted on 54 plots in Douglas County, Wisconsin. On each plot, 15 vegetative and 15 staminate flower buds were examined and the number of larvae in each bud was recorded. These data were utilized to develop the mathematical model describing the density-frequency relationship. (Figure 1). Several multiple regression equations involving logarithmic and polynomial transformations were tested to mathematically model the relationship. The trinomial equation, where Y=total larvae per plot, and X=total infested buds per plot was selected as the best model:

$$Y = -0.579 + 1.376X - 0.0356X^2 + 0.00174X^3$$

This regression analyses showed that the density of larvae was closely related to the frequency of buds infested, and that the correlation (R^2 = 95.153%) was very high.

It is recommended that the model be employed in surveying for early stage jack pine budworm larvae. Vegetative and flower buds may be examined for presence or absence of larvae. The critical level of 25 larvae per 30 buds will be attained when 19 of 30 buds are infested.

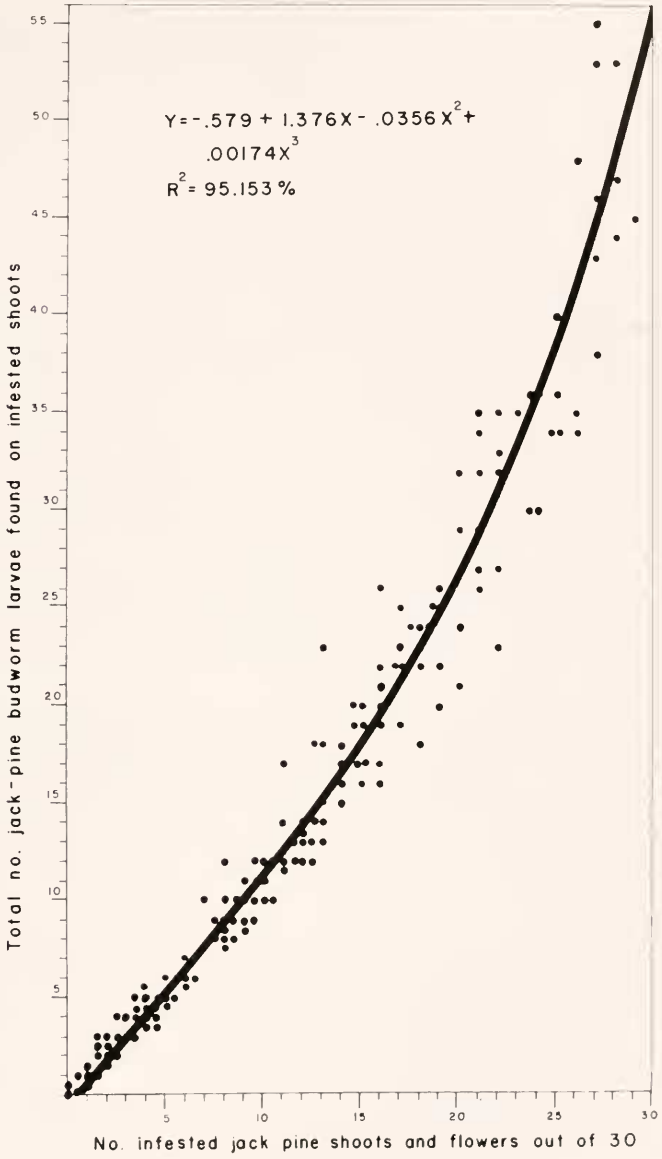

Figure 1. Relationship between early larval jack pine budworm density and the number of infested shoots and flowers. Douglas Co., Wis. 1971-73.